Advancements in weighing technology provide durable, highly-reliable load sensing devices

By Larry Behrens

Weight is a significant factor in multiple industries, including recycling, material handling, logistics, aggregates, and food and beverage. These industries rely on weighing solutions to deliver accurate, repeatable weighing results to help optimize operations and production, increase inventory management and enhance billing accuracy to ensure maximum revenue and customer satisfaction.

Electronic scale systems provide a convenient weighing solution for these industries, delivering high-accuracy records in a more time-efficient manner. Differing in load capacity and increment size, electronic scale systems meet diverse weighing needs—with a solution to suit various material types and sizes. Utilizing advanced technology and design features, electronic scales can withstand harsh conditions to accommodate varying weight applications—providing accurate, repeatable load sensing technology.

**Early technology**

Electronic scales use load cells to convert mechanical movement, or applied force, into an electrical signal. The load cell deflects while bearing a load, and the compression or tension force that has been applied yields a corresponding electrical signal that is read by the weight indication system. While different designs are available, the majority of load cells are based on the cantilever principle; one end of the load cell is fixed, and the other is suspended to absorb the force of the applied load. The suspended end then reverts to its initial position once the load is removed.

As this mechanical movement must be precise in order to deliver high-accuracy readings, early load cell technology was particularly susceptible to environmental forces that could influence this movement—such as shock and vibration. This made the load cell more challenging to apply in outdoor conditions, as well as in busy industrial environments.

To ensure continual, effective operation, additional mechanical devices such as expensive check rods and check plates were often required within these scale arrangements to help protect the load cell from damage. They also helped prevent extraneous loading from affecting the load cell’s operation. However, as with all mechanical scale parts, these devices are subject to wear, weather, and other deteriorating factors that reduce their overall operational life. Continual—and often costly—maintenance programs were required to ensure proper scale operation.

**A dependable solution**
To counter these issues, technology advancements resulted in all-electronic strain gauge weight sensors, designed to measure the applied load accurately, without experiencing problematic loading affects. This design ensures less fatigue, low failure rate, and exceptional overload protection. Delivering reliable, precise, and repeatable readings, in addition to weatherproof and shock-proof construction, this electronic weight sensor requires minimal maintenance to operate in harsh environments. Further, it provides increased longevity, allowing users to save a significant amount of money in the initial investment and ongoing maintenance.

**How it works**

The weight sensor is a steel structure with strain gauges, or electronic sensors, positioned on the outside surfaces—two sensors on the top and two on the bottom. As with most load cells, this structure acts as a cantilever, unsupported on one end and fixed on the other. When a load is applied on the unsupported end, the sensors detect strain in the structure and provide an analog mV/V output that represents weight. This output is interpreted by indicator electronics, and the weight indicator digitally displays the strain as the load’s weight.

The electronic weight sensor eliminates the undesirable loading effects in its operation by deflecting an appreciable amount under the maximum load. It effectively ignores unwanted force and ensures the weight sensor is unaffected by moment arm variations, providing consistent readings even when load placement differs.

**End loading and side loading**

When an end load is applied, the electronic weight sensor experiences a uniform compressive strain at all strain gauge locations. The sensor is wired to subtract the strain experienced on one end from the other, eliminating any additional applied force. For side loading, a neutral axis runs the length of the beam at a 90-degree angle to the applied force, causing no tension or compression at the top of the electronic weight sensor so the sensors do not measure the force from side loading.

**Torsion effect**
Any torque applied to the electronic weight sensor results in a strain—in this case, a 360-degree torsional shear strain—uniform at all strain gauge locations. Similarly to end loading, the sensor is wired to subtract the strain experienced on one end from the other, eliminating any torsion effect that could influence measurement of the applied load.

The electronic weight sensor deflects an appreciable amount—usually a fraction of an inch—under maximum load. This deflection of the structure absorbs the energy of the impact. This feature, combined with the end loading, side loading, and torsion effect, provides a linear weighing device that provides accurate, repeatable measurements.

**In the field**

Due to their dependability and versatile operation, advanced electronic weight sensors can be effectively implemented in multiple applications, ranging from floor scales and batching operations to forklift and truck scales. For example, shipping and distributing applications rely on accurate weighing to allow carriers to optimize revenue by precisely determining the weight of delivered freight. To ensure high-accuracy measurements, electronic weight sensors can be used in forklift scales, allowing forklift drivers to lift, then move and weigh loads en route. For this particular application, electronic weight sensors not only help to expedite operations, but maximize profits by verifying the customer pays for exactly the amount of freight transported instead of estimating the weight of each load.

In addition to shipping and distributing applications, the electronic weight sensor can easily be utilized in the transportation industry for truck scale applications. In these situations, scales are used not only to determine the weight of loads, but also to confirm vehicles meet stringent state and federal weight regulations. Truck scales with electronic weight sensors provide accurate measurements, which are critical in these applications to prevent excessive wear on vehicles, as well as roads.
Recycling applications can also benefit from an electronic weight sensors’ operation. For instance, a hauler truck utilizes a tipper, which includes a scale, to pick up a wheeled tote containing recyclables and a Radio Frequency Identification, or RFID, tag detailing the recycler’s information. An electronic weight sensor can be inserted between the hauler truck and its tipper, allowing recyclables to be weighed dynamically and eliminating pauses mid-lift to obtain readings. This ensures accurate weighing, in-motion, and facilitates easy documentation of all recyclables.

Moving forward

While the electronic weight sensor has proven to be an effective and reliable weighing solution, advancements in load cell technology continue to evolve. Today, advanced load cells feature multi-layered sealing processes to further protect them from harsh environments. Additionally, some load cells undergo a three-step treatment process during manufacturing to further ensure superior strength, repeatability, and low hysteresis. This allows electronic weight sensors to withstand everyday jolts and moisture penetration, delivering a long operational life.

In addition to sealing processes, advanced electronic weight sensors offer multiple types of construction to accommodate varying industry needs. For example, electronic weight sensors featuring rugged, aircraft-quality steel construction ensure continuous performance in severe applications. Further, some electronic weight sensors’ design utilizes stainless steel construction with fully welded NEMA 4X (IP68) shields, making them ideal for use in sanitary applications, such as in food and beverage manufacturing. These designs also include models with construction specifically for use in hazardous areas.
As weighing technology has proven to be a significant factor in a variety of industries, the use of load sensing devices is critical in these operations. Load sensing technology will continue to evolve to ensure repeatable and accurate weighing results to meet the diverse needs of each industry.

ABOUT THE AUTHOR

Larry Behrens (lbehrens@awtxglobal.com) is the Global Product manager for weighbridges and floor scale products at Avery Weigh-Tronix.

Source:

http://www.isa.org/InTechTemplate.cfm?Section=Control_Fundamentals1&template=/ContentManagement/ContentDisplay.cfm&ContentID=86957